WHAT IS CLAIMED IS:

1. A method of forming a multijunction solar cell comprising an upper subcell, a middle subcell, at least one lower subcell, said upper subcell and said lower subcell being substantially lattice-matched and said lower subcell being substantially lattice-mismatched, said method comprising:

providing a growth semiconductor substrate for the epitaxial growth of semiconductor material;

forming said upper subcell over said growth semiconductor substrate such that said upper subcell has a first, upper band gap and is substantially lattice-matched to said growth substrate;

forming said middle subcell over said upper subcell such that said middle subcell is substantially lattice-matched to said growth substrate and said middle subcell has a second middle band gap, said first upper band gap being larger than said second middle band gap;

forming said at least one lower subcell over said middle subcell such that said at least one lower subcell is substantially lattice-mismatched with respect to said growth substrate and said at least one lower subcell has a third lower band gap, said third lower band gap being smaller than said second middle band gap;

providing a support structure over said lower subcell; and

removing said growth semiconductor substrate.

2. The method of Claim 1, wherein said lattice mismatch between said lower subcell and said growth substrate is about 1% or greater.

3. The method of Claim 1, wherein said lattice mismatch between said lower subcell and said growth substrate is about 2% or greater.

4. The method of Claim 1, wherein said lattice mismatch between said lower subcell and said growth substrate is about 4% or greater.

5. The method of Claim 1, wherein said lattice mismatched between said lower subcell and said growth substrate is about 5% or greater.

6. The method of Claim 1, further comprising removing a portion of said support structure thereby reducing the weight of said support structure after removing said growth semiconductor substrate.

7. The method of Claim 6, wherein said support structure is formed by adhering a thin sheet to a rigid member using a non-permanent adhesive such that said rigid member is detachable from said thin sheet after said support substrate is bonded to said lower subcell and said growth semiconductor substrate is removed.

8. The method of Claim 7, further wherein one side of said thin sheet is metallized to provide electrical bonding to said lower subcell and to provide high reflectance.

9. The method of Claim 1, wherein providing a growth semiconductor substrate for epitaxial growth of semiconductor material comprises providing a substrate selected from the group consisting of a GaAs substrate, a Ge substrate, an InP substrate, and a Si substrate.

10. The method of Claim 1, wherein forming said upper subcell comprises growing $Ga_xIn_{1-x}P$ semiconductor material over said semiconductor growth substrate.

11. The method of Claim 1, wherein forming said middle subcell comprises growing $In_yGa_{1-y}As$ semiconductor material.

12. The method of Claim 1, wherein forming said lower subcell comprises depositing $In_yGa_{1-y}As$ semiconductor material over said middle subcell.

13. The method of Claim 1, wherein forming said lower subcell comprises depositing $Si_{(x)}Ge_{(1-x)}$ semiconductor material over said middle subcell.

14. The method of Claim 1, further comprising forming grading layers between said lower subcell and said middle subcell by growing InGaAs semiconductor material while increasing said In content and decreasing said Ga content to reduce stress in said lower subcell resulting from mismatch of lattice spacing.

15. The method of Claim 1, further comprising forming grading layers between said lower subcell and said middle subcell by growing $In_yGa_{1-y}As$ to reduce stress in said lower subcell resulting from mismatch of lattice spacing.

16. The method of Claim 1, further comprising forming a parting layer between said growth semiconductor substrate and said top subcell.

17. The method of Claim 16, further comprising preferentially etching said parting layer so as to remove said growth semiconductor substrate substantially intact for reuse.

18. The method of Claim 1, further comprising reusing said growth semiconductor substrate for epitaxial growth of semiconductor material after said step of removing said growth semiconductor substrate.

19. The method of Claim 1, wherein said semiconductor growth substrate is removed by etching the substrate.

20. The method of Claim 1, wherein first and second lower subcells are formed, said first lower subcell having a larger band gap than said second lower subcell.

21. The method of Claim 20, wherein said first lower subcell, said second lower subcell, and said middle subcell are formed by growing InGaAs based material and said upper subcell is formed by growing InGaP based material.

22. The method of Claim 21, further comprising forming grading layers between said first and second lower subcells by growing InGaAs semiconductor material while increasing said In content and decreasing said Ga content to reduce stress in said lower subcell resulting from mismatch of lattice spacing.

23. A multijunction solar cell for converting solar energy into electrical power, said multijunction solar cell comprising substantially unstrained subcells and substantially lattice-mismatched and strained subcells, said multijunction solar cell comprising:

a support structure having lateral spatial extent and sufficient rigidity for providing structural support for a plurality of layers of material forming said solar cell, said support structure including a metal surface across said lateral spatial extent for reflecting light that passes through said layers of material and reaches said support structure;

at least one lower subcell comprising semiconductor material disposed over said metal surface of said support structure, said lower subcell having a first lower band gap;

a middle subcell comprising semiconductor material disposed over said lower subcell, said middle subcell having a second middle band gap, said first lower band gap being smaller than said second middle band gap; and

an upper subcell comprising semiconductor material disposed over said middle subcell, said upper subcell having a third, upper band gap, said third upper band gap being larger than said second middle band gap,

wherein said upper subcell and said at least one lower subcell are substantially lattice-mismatched and said lower subcell is more strained than said upper subcell.

24. The multijunction solar cell of Claim 23, wherein said lattice mismatch between said lower subcell and said upper cell is about 1% or greater.

25. The multijunction solar cell of Claim 23, wherein said lattice mismatch between said lower subcell and said upper cell is about 2% or greater.

26. The multijunction solar cell of Claim 23, wherein said lattice mismatch between said lower subcell and said upper cell is about 4% or greater.

27. The multijunction solar cell of Claim 23, wherein said lattice mismatch between said lower subcell and said upper cell is about 5% or greater.

28. The multijunction solar cell of Claim 23, wherein said support structure comprises a semiconductor substrate having a metal layer formed thereon to reflect light passing through said plurality of subcells.

29. The multijunction solar cell of Claim 23, wherein said support structure comprises a plastic sheet having a top and bottom.

30. The multijunction solar cell of Claim 28, wherein said plastic sheet is metallized on top and bottom.

31. The multijunction solar cell of Claim 23, wherein said support structure comprises a metal wafer.

32. The multijunction solar cell of Claim 31, wherein said metal wafer further comprises a reflective optical coating formed thereon to provide increased optical reflectance.

33. The multijunction solar cell of Claim 23, wherein said metal surface across said lateral spatial extent of said support structure has a reflectivity of at least 90%.

34. The multijunction solar cell of Claim 23, wherein said metal surface across said lateral spatial extent of said support structure has a reflectivity of at least 95%.

35. The multijunction solar cell of Claim 23, wherein said lower subcell comprises InGaAs based material.

36. The multijunction solar cell of Claim 23, wherein said middle subcell comprises InGaAs based material.

37. The multijunction solar cell of Claim 23, further comprising grading layers between said lower subcell and said middle subcell, said grading layers comprising InGaAs wherein said In content increases and said Ga content decreases to reduce stress in said lower subcell resulting from mismatch of lattice spacing.

38. The multijunction solar cell of Claim 23, wherein said upper subcell comprises GaInP based material.

39. The multijunction solar cell of Claim 23, wherein said lower subcell and said middle subcell comprise InGaAs based material and said upper subcell comprises InGaP based material.

40. The multijunction solar cell of Claim 23, comprising first and second lower subcells.

41. The multijunction solar cell of Claim 40, wherein said first lower subcell, said said second lower subcell, and said middle subcell comprise InGaAs based material and said upper subcell comprises InGaP based material.

42. The multijunction solar cell of Claim 23, wherein said lower subcell comprises $Si_{(x)}Ge_{(1-x)}$.

43. A method of forming a multijunction solar cell comprising a high band gap substantially unstrained subcell and at least one lattice-mismatched low band gap subcell, the method comprising:

    providing a growth semiconductor substrate for the epitaxial growth of semiconductor material;

    forming the high band gap subcell over the growth semiconductor substrate, the high band gap subcell having a first high band gap.

    forming the at least one low band gap subcell over the high band gap subcell, the low band gap subcell having a second low band gap, the first high band gap being larger than the second low band gap, said growth substrate and said low band gap subcell having substantial lattice mismatch;

    providing a support substrate over the low band gap subcell; and

removing the growth semiconductor substrate.

44. The method of Claim 43, wherein said lattice mismatch between said low band gap subcell and said growth substrate is at least about 1%.

45. A multijunction solar cell for efficiently converting solar radiation into electrical power having lattice-mismatched subcells, the multijunction solar cell comprising:

a support structure having lateral spatial extent and sufficient rigidity for providing structural support for a plurality of layers of material forming the solar cell, the support structure including a metal surface across the lateral spatial extent of the support structure for reflecting light that passes through the layers of material and reaches the support structure;

at least one low band gap lattice-mismatched subcell comprising semiconductor material disposed over the metal surface of the support structure, the low band gap lattice-mismatched subcell having a low band gap; and

a high band gap subcell comprising semiconductor material disposed over the low band gap lattice-mismatched subcell, the high band gap subcell having a high band gap, the high band gap being larger than the low band gap,

wherein said low band gap lattice-mismatched subcell is substantially lattice-mismatched with respect to said high band gap subcell.

46. A multijunction solar cell having a high AM0 conversion efficiency at 28°C and both lattice-mismatched subcells and substantially unstrained subcells, the multijunction solar cell comprising:

a support structure having lateral spatial extent and sufficient rigidity for providing structural support for a plurality of layers of material forming the solar cell;

at least one lower lattice-mismatched subcell comprising semiconductor material disposed over the support structure, the lower lattice-mismatched subcell having a lower band gap; and

a substantially unstrained upper subcell comprising semiconductor material disposed over the lower subcell, the upper substantially unstrained subcell having an upper band gap, the upper band gap being larger than the lower band gap,

wherein said lattice-mismatched subcell is substantially lattice-mismatched with respect to said substantially unstrained upper subcell and said substantially unstrained upper subcell has sufficiently low strain such that said AM0 efficiency is at least about 30%.